

## SEQUENCE LISTING

## <110> ARTEMIS PHARMACEUTICALS GmbH

<120> Recombinant Influenza Viruses with Bicistronic vRNAs Coding for Two Genes in Tandem Arrangement

```
<130> Kreisler 1092-KGB
```

<140>

<141>

<160> 24

<170> PatentIn Ver. 2.1

<210> 1

<211> 12

<212> RNA

<213> Influenza A virus

<400> 1

ccugcuuuug cu

12

<210> 2

<211> 12

<212> RNA

<213> Influenza B virus

<400> 2

nnygcuucug cu

12

<210> 3

<211> 12

<212> RNA

<213> Influenza C virus

<400> 3

ccugcuucug cu

12

<210> 4

<211> 12

<212> RNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Modified
 influenza A 3'-sequence (pHL1104 and pHL1920)

<400> 4

ccuguuucua cu

12

<210> 5 <211> 12 <212> RNA <213> Artificial Sequence <220> <223> Description of Artificial Sequence: Modified influenza A 3'-sequence (pHL1948) <400> 5 12 ccugguucuc cu <210> 6 <211> 13 <212> RNA <213> Influenza A virus <400> 6 13 aguagaaaca agg <210> 7 <211> 13 <212> RNA <213> Influenza B virus <220> <221> misc feature <222> (12)..(13) <223> n=any nucleotide <400> 7 13 aguagwaaca rnn <210> 8 <211> 13 <212> RNA <213> Influenza C virus <400> 8 13 agcaguagca agr <210> 9 <211> 13 <212> RNA <213> Artificial Sequence <223> Description of Artificial Sequence: Modified influenza A 5'-sequence (pHL1920) <400> 9

agaagaauca agg	13
<210> 10	
<211> 21	
<212> RNA	
<213> Influenza A virus	
<400> 10	
aguagaaaca aggnnnuuuu u	21
<210> 11	
<211> 21	
<212> RNA	
<213> Artificial Sequence	
<220>	
<223> Description of Artificial Sequence: Modified influenza A 5'-sequence (pHL1920)	
<400> 11	
agaagaauca aggnnnuuuu u	21
<210> 12	
<211> 21	
<212> RNA	
<213> Influenza B virus	
<400> 12	
aguagwaaca rnnnnnuuuu u	21
<210> 13	
<211> 19	
<212> RNA	
<213> Artificial Sequence	
<220>	
<pre>&lt;223&gt; Description of Artificial Sequence: Modified   influenza C 5'-sequence</pre>	
<400> 13	
aguaguaaca agrguuuuu	19
<210> 14	
<211> 15	
<212> RNA	
<213> Artificial Sequence	
<220>	
<223> Description of Artificial Sequence: Modified	
influenza A 3'-sequence (pHL1104 and pHL1920)	
<400> 14	
nnnccuguuu cuacu	15

<210><211><212><213>	15	
	Description of Artificial Sequence: Modified influenza A 3'-sequence (pHL1948)	
<400> nnnccu		15
<210><211><212><212><213>	15	
<220> <223>	Description of Artificial Sequence: Modified influenza B 3' sequence	
<400> nnnnny	16 guuu cuacu	15
<210><211><211><212><213>	14	
<220> <223>	Description of Artificial Sequence: Modified influenza C 3'-sequence	
<400>	17 guuuc uacu	14
<210><211><212><213>	10	
<400> aggtad		10
<210><211><211><212><213>	32	
<400> gctga	19 aaaat gatcttcttg aaaattgcag gc	32
<210>		

<212> DNA <213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: pHL1920

<400> 20

```
cccaaaaaaa aaaaaaaaa aaaaaaaaa agtccagagt ggccccgccg ttccgcgccg 60
ggggggggg gggggggga cactttcgga catctggtcg acctccagca tcgggggaaa 120
aaaaaaaaac aaagtttcgc ccggagtact ggtcgacctc cgaagttggg ggggagtaga 180
aacagggtag ataatcactc actgagtgac atccacatcg cgagcgcgcg taatacgact 240
cactataggg cgaattgggt accgggcccc ccctcgaggt cgacggtatc gataagcttc 300
qacqaqattt tcaqqaqcta aggaagctaa aatggagaaa aaaatcactg gatataccac 360
cgttgatata tcccaatggc atcgtaaaga acattttgag gcatttcagt cagttgctca 420
atgtacctat aaccagaccg ttcagctgga tattacggcc tttttaaaga ccgtaaagaa 480
aaataaqcac aagttttatc cggcctttat tcacattctt gcccgcctga tgaatgctca 540
tccggaattc cgtatggcaa tgaaagacgg tgagctggtg atatgggata gtgttcaccc 600
ttgttacacc gttttccatg agcaaactga aacgttttca tcgctctgga gtgaatacca 660
cgacgatttc cggcagtttc tacacatata ttcgcaagat gtggcgtgtt acggtgaaaa 720
cctggcctat ttccctaaag ggtttattga gaatatgttt ttcgtctcag ccaatccctg 780
ggtgagtttc accagttttg atttaaacgt ggccaatatg gacaacttct tcgcccccgt 840
tttcaccatg ggcaaatatt atacgcaagg cgacaaggtg ctgatgccgc tggcgattca 900
ggttcatcat gccgtttgtg atggcttcca tgtcggcaga atgcttaatg aattacaaca 960
gtactgcgat gagtggcagg gcggggcgta attttttaa ggcagttatt ggtgccctta 1020
aacgcctggt gctacgcctg aataagtgat aataagcgga tgaatggcag aaattcgtcg 1080
aagettgata tegaatteet geageeeggg ggateeacta gttetagage ggeegeeace 1140
geggtggage tecagetttt gtteeettta gtgagggtta attgegegea ggeetageta 1200
ggtaaagaaa aatacccttg attcttctaa taacccggcg gcccaaaatg ccgactcgga 1260
gcgaaagata tacctccccc ggggccggga ggtcgcgtca ccgaccacgc cgccggccca 1320
ggcgacgcgc gacacggaca cctgtcccca aaaacgccac catcgcagcc acacacggag 1380
cgcccggggc cctctggtca accccaggac acacgcggga gcagcgccgg gccggggacg 1440
ccctcccggc cgcccgtgcc acacgcaggg ggccggcccg tgtctccaga gcgggagccg 1500
gaagcatttt cggccggccc ctcctacgac cgggacacac gagggaccga aggccggcca 1560
ggegegacet etegggeege aegegegete agggageget eteegactee geaegggae 1620
tcgccagaaa ggatcgtgac ctgcattaat gaatcagggg ataacgcagg aaagaacatg 1680
tgagcaaaag gccagcaaaa ggccaggaac cgtaaaaagg ccgcgttgct ggcgtttttc 1740
cataggetee geceeettga egageateae aaaaategae geteaagtea gaggtggega 1800
aacccgacag gactataaag ataccaggcg tttccccctg gaagctccct cgtgcgctct 1860
cctgttccga ccctgccgct taccggatac ctgtccgcct ttctcccttc gggaagcgtg 1920
gegetttete atageteacg etgtaggtat etcagttegg tgtaggtegt tegeteeaag 1980
ctgggctgtg tgcacgaacc ccccgttcag cccgaccgct gcgccttatc cggtaactat 2040
cgtcttgagt ccaacccggt aagacacgac ttatcgccac tggcagcagc cactggtaac 2100
aggattagca gagcgaggta tgtaggcggt gctacagagt tcttgaagtg gtggcctaac 2160
tacggctaca ctagaaggac agtatttggt atctgcgctc tgctgaagcc agttaccttc 2220
ggaaaaagag ttggtagctc ttgatccggc aaacaaacca ccgctggtag cggtggtttt 2280
tttgtttgca agcagcagat tacgcgcaga aaaaaaggat ctcaagaaga tcctttgatc 2340
ttttctacgg ggtctgacgc tcagtggaac gaaaactcac gttaagggat tttggtcatg 2400
agattatcaa aaaggatctt cacctagatc cttttaaatt aaaaatgaag ttttaaatca 2460
atctaaagta tatatgagta aacttggtct gacagttacc aatgcttaat cagtgaggca 2520
cctatctcag cgatctgtct atttcgttca tccatagttg cctgactccc cgtcgtgtag 2580
ataactacga tacgggaggg cttaccatct ggccccagtg ctgcaatgat accgcgagac 2640
ccacgeteae eggetecaga tttateagea ataaaceage eageeggaag ggeegagege 2700
agaagtggtc ctgcaacttt atccgcctcc atccagtcta ttaattgttg ccgggaagct 2760
agagtaagta gttcgccagt taatagtttg cgcaacgttg ttgccattgc tacaggcatc 2820
gtggtgtcac gctcgtcgtt tggtatggct tcattcagct ccggttccca acgatcaagg 2880
cgagttacat gatcccccat gttgtgcaaa aaagcggtta gctccttcgg tcctccgatc 2940
gttgtcagaa gtaagttggc cgcagtgtta tcactcatgg ttatggcagc actgcataat 3000
```

```
tctcttactg tcatgccatc cgtaagatgc ttttctgtga ctggtgagta ctcaaccaag 3060
tcattctgag aatagtgtat gcggcgaccg agttgctctt gcccggcgtc aacacgggat 3120
aataccgcgc cacatagcag aactttaaaa gtgctcatca ttggaaaacg ttcttcgggg 3180
cgaaaactct caaggatctt accgctgttg agatccagtt cgatgtaacc cactcgtgca 3240
cccaactgat cttcagcatc ttttactttc accagcgttt ctgggtgagc aaaaacagga 3300
aggcaaaatg ccgcaaaaaa gggaataagg gcgacacgga aatgttgaat actcatactc 3360
ttcctttttc aatattattg aagcatttat cagggttatt gtctcatgag cggatacata 3420
tttgaatgta tttagaaaaa taaacaaaag agtttgtaga aacgcaaaaa ggccatccgt 3480
caggatggcc ttctgcttaa tttgatgcct ggcagtttat ggcgggcgtc ctgcccgcca 3540
ccctccgggc cgttgcttcg caacgttcaa atccgctccc ggcggatttg tcctactcag 3600
gagagcgttc accgacaaac aacagataaa acgaaaggcc cagtctttcg actgagcctt 3660
tcgttttatt tgatgcctgg cagttcccta ctctcgcatg gggagacccc acactaccat 3720
cggcgctacg gcgtttcact tctgagttcg gcatggggtc aggtgggacc accgcgctac 3780
tgccgccagg caaattctgt tttatcagac cgcttctgcg ttctgattta atctgtatca 3840
                                                                  3888
ggctgaaaat cttctctcat ccgccaaaac agaagctagc ggccgatc
<210> 21
<211> 4500
<212> DNA
<213> Artificial Sequence
<220>
<223> Description of Artificial Sequence: pHL3196
<400> 21
agtagaaaca gggtagataa tcactcactg agtgacatcc acatcgcgag cgcgaaggta 60
cgttctcgag cgcgcgtaat acgactcact atagggcgaa ttgggtacgt tccatcatgg 120
agaaaaaaat cactggatat accaccgttg atatatccca atggcatcgt aaagaacatt 180
ttgaggcatt tcagtcagtt gctcaatgta cctataacca gaccgttcag ctggatatta 240
cggccttttt aaagaccgta aagaaaaata agcacaagtt ttatccggcc tttattcaca 300
ttottgooog cotgatgaat gotoatoogg aattoogtat ggcaatgaaa gacggtgagc 360
tggtgatatg ggatagtgtt cacccttgtt acaccgtttt ccatgagcaa actgaaacgt 420
tttcatcgct ctggagtgaa taccacgacg atttccggca gtttctacac atatattcgc 480
aagatgtggc gtgttacggt gaaaacctgg cctatttccc taaagggttt attgagaata 540
tgtttttcgt ctcagccaat ccctgggtga gtttcaccag ttttgattta aacgtggcca 600
atatggacaa cttcttcgcc cccgttttca ccatgggcaa atattatacg caaggcgaca 660
aggtgctgat gccgctggcg attcaggttc atcatgccgt ctgtgatggc ttccatgtcg 720
gcagaatgct taatgaatta caacagtact gcgatgagtg gcagggcggg gcgcgttaac 780
gagatcagct gaaaaatgat cttcttgaaa atttgcaggc cgtacgtgta ccgggccccc 840
cctcgactcg cgaaggagtc caccatgagt aaaggagaag aacttttcac tggagttgtc 900
ccaattcttg ttgaattaga tggtgatgtt aatgggcaca aattttctgt cagtggagag 960
ggtgaaggtg atgcaacata cggaaaactt acccttaaat ttatttgcac tactggaaaa 1020
ctacctgttc catggccaac acttgtcact actttcactt atggtgttca atgcttttca 1080
agatacccag atcatatgaa acagcatgac tttttcaaga gtgccatgcc cgaaggttat 1140
gtacaggaaa gaactatatt tttcaaagat gacgggaact acaagacacg tgctgaagtc 1200
aagtttgaag gtgataccct tgttaataga atcgagttaa aaggtattga ttttaaagaa 1260
gatggaaaca ttcttggaca caaattggaa tacaactata actcacacaa tgtatacatc 1320
atggctgaca agcagaagaa cggaatcaag gccaacttca agacccgcca caacatcgag 1380
gacggcggcg tgcagctggc cgaccactac cagcagaaca ccccaattgg cgatggccct 1440
gtccttttac cagacaacca ttacctgtcc acacaatctg ccctttcgaa agatcccaac 1500
gaaaagagag accacatggt ccttcttgag tttgtaacag ctgctgggat tacacatggc 1560
```

atggatgaac tatacaaggg atcccatcac catcaccatc actaagctcc atggtctaga 1620 tatcgatagg cctagctagg taaagaaaaa tacccttgtt tctactaata acccggcggc 1680 ccaaaatgcc gactcggagc gaaagatata cctcccccgg ggccgggagg tcgcgtcacc 1740 gaccacgccg ccggcccagg cgacgcgcga cacggacacc tgtccccaaa aacgccacca 1800 tcgcagccac acacggagcg cccggggccc tctggtcaac cccaggacac acgcgggagc 1860

```
agegeeggge eggggaegee eteceggeeg eeegtgeeae aegeaggggg eeggeeegtg 1920
tctccagagc gggagccgga agcattttcg gccggcccct cctacgaccg ggacacacga 1980
gggaccgaag gccggccagg cgcgacctct cgggccgcac gcgcgctcag ggagcgctct 2040
ccgactccgc acggggactc gccagaaagg atcgtgacct gcattaatga atcaggggat 2100
aacgcaggaa agaacatgtg agcaaaaggc cagcaaaagg ccaggaaccg taaaaaggcc 2160
gcgttgctgg cgtttttcca taggctccgc cccctgacg agcatcacaa aaatcgacgc 2220
tcaagtcaga ggtggcgaaa cccgacagga ctataaagat accaggcgtt tccccctgga 2280
ageteceteg tgegetetee tgtteegace etgeegetta eeggataeet gteegeettt 2340
ctcccttcgg gaagcgtggc gctttctcat agctcacgct gtaggtatct cagttcggtg 2400
taggtcgttc gctccaagct gggctgtgtg cacgaacccc ccgttcagcc cgaccgctgc 2460
gccttatccg gtaactatcg tcttgagtcc aacccggtaa gacacgactt atcgccactg 2520
gcagcagcca ctggtaacag gattagcaga gcgaggtatg taggcggtgc tacagagttc 2580
ttgaagtggt ggcctaacta cggctacact agaaggacag tatttggtat ctgcgctctg 2640
ctgaagccag ttaccttcgg aaaaagagtt ggtagctctt gatccggcaa acaaaccacc 2700
gctggtagcg gtggtttttt tgtttgcaag cagcagatta cgcgcagaaa aaaaggatct 2760
caagaagatc ctttgatctt ttctacgggg tctgacgctc agtggaacga aaactcacgt 2820
taagggattt tggtcatgag attatcaaaa aggatcttca cctagatcct tttaaattaa 2880
aaatgaagtt ttaaatcaat ctaaagtata tatgagtaaa cttggtctga cagttaccaa 2940
tgcttaatca gtgaggcacc tatctcagcg atctgtctat ttcgttcatc catagttgcc 3000
tgactccccg tcgtgtagat aactacgata cgggagggct taccatctgg ccccagtgct 3060
gcaatgatac cgcgagaccc acgctcaccg gctccagatt tatcagcaat aaaccagcca 3120
gccggaaggg ccgagcgcag aagtggtcct gcaactttat ccgcctccat ccagtctatt 3180
aattgttgcc gggaagctag agtaagtagt tcgccagtta atagtttgcg caacgttgtt 3240
gccattgcta caggcatcgt ggtgtcacgc tcgtcgtttg gtatggcttc attcagctcc 3300
ggttcccaac gatcaaggcg agttacatga tcccccatgt tgtgcaaaaa agcggttagc 3360
tccttcggtc ctccgatcgt tgtcagaagt aagttggccg cagtgttatc actcatggtt 3420
atggcagcac tgcataattc tcttactgtc atgccatccg taagatgctt ttctgtgact 3480
ggtgagtact caaccaagtc attctgagaa tagtgtatgc ggcgaccgag ttgctcttgc 3540
ccggcgtcaa cacgggataa taccgcgcca catagcagaa ctttaaaagt gctcatcatt 3600
ggaaaacgtt cttcggggcg aaaactctca aggatcttac cgctgttgag atccagttcg 3660
atgtaaccca ctcgtgcacc caactgatct tcagcatctt ttactttcac cagcgtttct 3720
gggtgagcaa aaacaggaag gcaaaatgcc gcaaaaaagg gaataagggc gacacggaaa 3780
tgttgaatac tcatactctt cctttttcaa tattattgaa gcatttatca gggttattgt 3840
ctcatgagcg gatacatatt tgaatgtatt tagaaaaata aacaaaagag tttgtagaaa 3900
cgcaaaaagg ccatccgtca ggatggcctt ctgcttaatt tgatgcctgg cagtttatgg 3960
egggegteet geeegeeace eteegggeeg ttgettegea aegtteaaat eegeteeegg 4020
cggatttgtc ctactcagga gagcgttcac cgacaaacaa cagataaaac gaaaggccca 4080
gtctttcgac tgagcctttc gttttatttg atgcctggca gttccctact ctcgcatggg 4140
gagaccccac actaccatcg gcgctacggc gtttcacttc tgagttcggc atggggtcag 4200
gtgggaccac cgcgctactg ccgccaggca aattctgttt tatcagaccg cttctgcgtt 4260
ctgatttaat ctgtatcagg ctgaaaatct tctctcatcc gccaaaacag aagctagcgg 4320
ccgatcccca aaaaaaaaaa aaaaaaaaaa aaaaagagtc cagagtggcc ccgccgttcc 4380
gcgccggggg gggggggggggacact ttcggacatc tggtcgacct ccagcatcgg 4440
gggaaaaaaa aaaaacaaag tttcgcccgg agtactggtc gacctccgaa gttggggggg 4500
```

```
<210> 22
<211> 4721
<212> DNA
<213> Artificial Sequence
<220>
<223> Description of Artificial Sequence: pHL3224
```

<400> 22 atctagacca tggagcttag tgatggtgat ggtgatggga tcccttgtat agttcatcca 60 tgccatgtgt aatcccagca gctgttacaa actcaagaag gaccatgtgg tctctctttt 120

```
cgttgggatc tttcgaaagg gcagattgtg tggacaggta atggttgtct ggtaaaagga 180
caqqqccatc gccaattggg gtgttctgct ggtagtggtc ggccagctgc acgccgccgt 240
cctcgatgtt gtggcgggtc ttgaagttgg ccttgattcc gttcttctgc ttgtcagcca 300
tgatgtatac attgtgtgag ttatagttgt attccaattt gtgtccaaga atgtttccat 360
cttctttaaa atcaatacct tttaactcga ttctattaac aagggtatca ccttcaaact 420
tgacttcagc acgtgtcttg tagttcccgt catctttgaa aaatatagtt ctttcctgta 480
cataaccttc gggcatggca ctcttgaaaa agtcatgctg tttcatatga tctgggtatc 540
ttgaaaagca ttgaacacca taagtgaaag tagtgacaag tgttggccat ggaacaggta 600
gttttccagt agtgcaaata aatttaaggg taagttttcc gtatgttgca tcaccttcac 660
cctctccact gacagaaaat ttgtgcccat taacatcacc atctaattca acaagaattg 720
qqacaactcc agtgaaaagt tcttctcctt tactcatggt ggactccttc gcgagtcgag 780
ggggggcccg gtacacgtac gcgctcgaga acgtaccttc gcgctcgcga tgtggatgtc 840
actcagtgag tgattatcta ccctgtttct actcccccc aacttcggag gtcgaccagt 900
actocgggcg aaactttgtt ttttttttt cccccgatgc tggaggtcga ccagatgtcc 960
qaaagtqtcc ccccccccc cccccccgg cgcggaacgg cggggccact ctggactctt 1020
tttttttt tttttttt ttttggggat cggccgctag cttctgtttt ggcggatgag 1080
agaagatttt cagcctgata cagattaaat cagaacgcag aagcggtctg ataaaacaga 1140
atttgcctgg cggcagtagc gcggtggtcc cacctgaccc catgccgaac tcagaagtga 1200
aacgccgtag cgccgatggt agtgtggggt ctccccatgc gagagtaggg aactgccagg 1260
catcaaataa aacgaaaggc tcagtcgaaa gactgggcct ttcgttttat ctgttgtttg 1320
teggtgaaeg eteteetgag taggacaaat eegeegggag eggatttgaa egttgegaag 1380
caacggcccg gagggtggcg ggcaggacgc ccgccataaa ctgccaggca tcaaattaag 1440
cagaaggcca tcctgacgga tggccttttt gcgtttctac aaactctttt gtttattttt 1500
ctaaatacat tcaaatatgt atccgctcat gagacaataa ccctgataaa tgcttcaata 1560
atattgaaaa aggaagagta tgagtattca acatttccgt gtcgccctta ttcccttttt 1620
tgcggcattt tgccttcctg tttttgctca cccagaaacg ctggtgaaag taaaagatgc 1680
tgaagatcag ttgggtgcac gagtgggtta catcgaactg gatctcaaca gcggtaagat 1740
ccttgagagt tttcgccccg aagaacgttt tccaatgatg agcactttta aagttctgct 1800
atgtggcgcg gtattatccc gtgttgacgc cgggcaagag caactcggtc gccgcataca 1860
ctattctcag aatgacttgg ttgagtactc accagtcaca gaaaagcatc ttacggatgg 1920
catgacagta agagaattat gcagtgctgc cataaccatg agtgataaca ctgcggccaa 1980
cttacttctg acaacgatcg gaggaccgaa ggagctaacc gcttttttgc acaacatggg 2040
ggatcatgta actcgccttg atcgttggga accggagctg aatgaagcca taccaaacga 2100
cgagcgtgac accacgatgc ctgtagcaat ggcaacaacg ttgcgcaaac tattaactgg 2160
cgaactactt actctagctt cccggcaaca attaatagac tggatggagg cggataaagt 2220
tgcaggacca cttctgcgct cggcccttcc ggctggctgg tttattgctg ataaatctgg 2280
agccggtgag cgtgggtctc gcggtatcat tgcagcactg gggccagatg gtaagccctc 2340
ccgtatcgta gttatctaca cgacggggag tcaggcaact atggatgaac gaaatagaca 2400
gatcgctgag ataggtgcct cactgattaa gcattggtaa ctgtcagacc aagtttactc 2460
atatatattt taqattgatt taaaacttca tttttaattt aaaaggatct aggtgaagat 2520
cctttttgat aatctcatga ccaaaatccc ttaacgtgag ttttcgttcc actgagcgtc 2580
agaccccgta gaaaagatca aaggatcttc ttgagatcct ttttttctgc gcgtaatctg 2640
ctgcttgcaa acaaaaaaac caccgctacc agcggtggtt tgtttgccgg atcaagagct 2700
accaactett ttteegaagg taactggett eageagageg eagataceaa atactgteet 2760
tctagtgtag ccgtagttag gccaccactt caagaactct gtagcaccgc ctacatacct 2820
cgctctgcta atcctgttac cagtggctgc tgccagtggc gataagtcgt gtcttaccgg 2880
gttggactca agacgatagt taccggataa ggcgcagcgg tcgggctgaa cggggggttc 2940
gtgcacacag cccagcttgg agcgaacgac ctacaccgaa ctgagatacc tacagcgtga 3000
gctatgagaa agcgccacgc ttcccgaagg gagaaaggcg gacaggtatc cggtaagcgg 3060
cagggtcgga acaggagagc gcacgaggga gcttccaggg ggaaacgcct ggtatcttta 3120
tagtcctgtc gggtttcgcc acctctgact tgagcgtcga tttttgtgat gctcgtcagg 3180
ggggcggagc ctatggaaaa acgccagcaa cgcggccttt ttacggttcc tggccttttg 3240
ctggcctttt gctcacatgt tctttcctgc gttatcccct gattcattaa tgcaggtcac 3300
gatectttet ggegagtece egtgeggagt eggagagege teeetgageg egegtgegge 3360
ccgagaggtc gcgcctggcc ggccttcggt ccctcgtgtg tcccggtcgt aggagggcc 3420
qqccqaaaat gcttccggct cccgctctgg agacacgggc cggccccctg cgtgtggcac 3480
qqqcqgccgq gagggcgtcc ccggcccggc gctgctcccg cgtgtgtcct ggggttgacc 3540
```

```
agagggcccc gggcgctccg tgtgtggctg cgatggtggc gtttttgggg acaggtgtcc 3600
gtgtcgcgcg tcgcctgggc cggcggcgtg gtcggtgacg cgacctcccg gccccggggg 3660
aggtatatct ttcgctccga gtcggcattt tgggccgccg ggttattagt agaaacaagg 3720
gtatttttct ttacctagct aggcctgcgc gcaattaacc ctcactaaag ggaacaaaag 3780
ctggagctcc accgcggtgg cggccgctct agaactagtg gatcccccgg gctgcaggaa 3840
ttcgatatca agcttcgacg aatttctgcc attcatccgc ttattatcac ttattcaggc 3900
gtagcaccag gcgtttaagg gcaccaataa ctgccttaaa aaaattacgc cccgccctgc 3960
cactcatcgc agtactgttg taattcatta agcattctgc cgacatggaa gccatcacaa 4020
acggcatgat gaacctgaat cgccagcggc atcagcacct tgtcgccttg cgtataatat 4080
ttgcccatgg tgaaaacggg ggcgaagaag ttgtccatat tggccacgtt taaatcaaaa 4140
ctggtgaaac tcacccaggg attggctgag acgaaaaaca tattctcaat aaacccttta 4200
gggaaatagg ccaggttttc accgtaacac gccacatctt gcgaatatat gtgtagaaac 4260
tgccggaaat cgtcgtggta ttcactccag agcgatgaaa acgtttcagt ttgctcatgg 4320
aaaacggtgt aacaagggtg aacactatcc catatcacca gctcaccgtc tttcattgcc 4380
atacggaatt ccggatgagc attcatcagg cgggcaagaa tgtgaataaa ggccggataa 4440
aacttgtgct tatttttctt tacggtcttt aaaaaggccg taatatccag ctgaacggtc 4500
tggttatagg tacattgagc aactgactga aatgcctcaa aatgttcttt acgatgccat 4560
tgggatatat caacggtggt atatccagtg atttttttct ccattttagc ttccttagct 4620
cctgaaaatc tcgtcgaagc ttatcgatac cgtcgacctc gagggggggc ccggtacggc 4680
ctgcaaattt tcaagaagat catttttcag ctgatctcgt t
                                                                  4721
<210> 23
<211> 5517
<212> DNA
<213> Artificial Sequence
<220>
<223> Description of Artificial Sequence: pHL3235
<400> 23
agtagaaaca gggtagataa tcactcactg agtgacatcc acatcgcgag cgcgaaggta 60
cgttctcgag cgcgcgtaat acgactcact atagggcgaa ttgggtacgt tccatcatgg 120
agaaaaaaat cactggatat accaccgttg atatatccca atggcatcgt aaagaacatt 180
ttgaggcatt tcagtcagtt gctcaatgta cctataacca gaccgttcag ctggatatta 240
cggccttttt aaagaccgta aagaaaaata agcacaagtt ttatccggcc tttattcaca 300
ttcttgcccg cctgatgaat gctcatccgg aattccgtat ggcaatgaaa gacggtgagc 360
tggtgatatg ggatagtgtt cacccttgtt acaccgtttt ccatgagcaa actgaaacgt 420
tttcatcgct ctggagtgaa taccacgacg atttccggca gtttctacac atatattcgc 480
aagatgtggc gtgttacggt gaaaacctgg cctatttccc taaagggttt attgagaata 540
tgtttttcgt ctcagccaat ccctgggtga gtttcaccag ttttgattta aacgtggcca 600
atatggacaa cttcttcgcc cccgttttca ccatgggcaa atattatacg caaggcgaca 660
aggtgetgat geegetggeg atteaggtte ateatgeegt etgtgatgge tteeatgteg 720
gcagaatgct taatgaatta caacagtact gcgatgagtg gcagggcggg gcgcgttaac 780
gagatcagct gaaaaatgat cttcttgaaa atttgcaggc cgtacgtgta ccgggccccc 840
cctcgactcg cgaaggagtc caccatgagt aaaggagaag aacttttcac tggagttgtc 900
ccaattcttg ttgaattaga tggtgatgtt aatgggcaca aattttctgt cagtggagag 960
ggtgaaggtg atgcaacata cggaaaactt accettaaat ttatttgcac tactggaaaa 1020
ctacctgttc catggccaac acttgtcact actttcactt atggtgttca atgcttttca 1080
agatacccag atcatatgaa acagcatgac tttttcaaga gtgccatgcc cgaaggttat 1140
gtacaggaaa gaactatatt tttcaaagat gacgggaact acaagacacg tgctgaagtc 1200
aagtttgaag gtgataccct tgttaataga atcgagttaa aaggtattga ttttaaagaa 1260
gatggaaaca ttcttggaca caaattggaa tacaactata actcacacaa tgtatacatc 1320
atggctgaca agcagaagaa cggaatcaag gccaacttca agacccgcca caacatcgag 1380
gacggcggcg tgcagctggc cgaccactac cagcagaaca ccccaattgg cgatggccct 1440
gtccttttac cagacaacca ttacctgtcc acacaatctg ccctttcgaa agatcccaac 1500
gaaaagagag accacatggt ccttcttgag tttgtaacag ctgctgggat tacacatggc 1560
```

atggatgaac tatacaaggg atcttcatga tctcagcaaa ctcttccttc ttaatccttc 1620 cagactegaa gteaattegt geateaatee gggeeetaga caccatggee tecaccatae 1680 tggaaattcc aactggtctt ctgtatgagc tgctagggaa gaatttctcg aataggttgc 1740 aacacttctg gtacatttgt tcatcctcaa ggattcccct ttgactcgta ttgagaatgg 1800 aacggtttct cttagggatc caagagtgtg tagttgccac agcatcatat tccatgcttt 1860 tggctggacc atgggctggc attaccgcag cattgtttac agattcaatt tccttatgac 1920 tgacaaacgg gttcatggga ttacaaagtc ttccctgata gtcttcatcc attagttccc 1980 atttcaggca aacttccggg atgtggagat tccgaatgtt gtacaggttt ggtccgccat 2040 ctgaaaccaa cagtcctgcc tttgagcggg tctgctccca cagcttcttt agctcgaatg 2100 acctcctcgt ttggatttgt gtgtctcccc tgtgacaccg gtatgtatat ctgtagtcct 2160 tgatgaataa ttggagagcc atttgggctg ttgccggtcc aagatcattg tttatcatgt 2220 tattetttat cactgttact ccaatgetea tateageega tteattaatt cetgatacte 2280 caaagctggg caactccata ctaaaattgg ctacaaatcc atagcggtag aaaaagcttg 2340 tgaattcgaa tgttcctgtc ctatttatat aggacttttt cttgctcata ttgatcccaa 2400 ctagettgca ggttetgtag aatetateea etceegettg tatteeetca tgatttggtg 2460 cattcacgat gagagcaaaa tcatcagagg actgaagtcc atcccaccag tatgtggttt 2520 tggtgtatct cttttgccca agattcagga ttgagactcc caacactgta ctcagcatgt 2580 tgaacatacc catcatcatt cccgggctta atgaggctgt gccgtctatt atgagaggat 2640 cgataggcct agctaggtaa agaaaaatac ccttgtttct actaataacc cggcggccca 2700 aaatgccgac tcggagcgaa agatatacct cccccggggc cgggaggtcg cgtcaccgac 2760 cacgccgccg gcccaggcga cgcgcgacac ggacacctgt ccccaaaaac gccaccatcg 2820 cagccacaca cggagcgccc ggggccctct ggtcaacccc aggacacacg cgggagcagc 2880 gccgggccgg ggacgccctc ccggccgccc gtgccacacg cagggggccg gcccgtgtct 2940 ccagageggg ageeggaage atttteggee ggeeeeteet aegaeeggga cacaegaggg 3000 accgaaggcc ggccaggcgc gacctctcgg gccgcacgcg cgctcaggga gcgctctccg 3060 actocgcacg gggactogco agaaaggato gtgacotgca ttaatgaato aggggataac 3120 gcaggaaaga acatgtgagc aaaaggccag caaaaggcca ggaaccgtaa aaaggccgcg 3180 ttgctggcgt ttttccatag gctccgccc cctgacgagc atcacaaaaa tcgacgctca 3240 agtcagaggt ggcgaaaccc gacaggacta taaagatacc aggcgtttcc ccctggaagc 3300 teeetegtge geteteetgt teegaceetg eegettaceg gatacetgte egeetttete 3360 ccttcgggaa gcgtggcgct ttctcatagc tcacgctgta ggtatctcag ttcggtgtag 3420 qtcqttcqct ccaagetggg ctgtgtgcac gaaceceeeg ttcageeega ccgctgegec 3480 ttatccggta actatcgtct tgagtccaac ccggtaagac acgacttatc gccactggca 3540 gcagccactg gtaacaggat tagcagagcg aggtatgtag gcggtgctac agagttcttg 3600 aagtggtggc ctaactacgg ctacactaga aggacagtat ttggtatctg cgctctgctg 3660 aagccagtta ccttcggaaa aagagttggt agctcttgat ccggcaaaca aaccaccgct 3720 ggtagcggtg gtttttttgt ttgcaagcag cagattacgc gcagaaaaaa aggatctcaa 3780 gaagateett tgatetttte taeggggtet gaegeteagt ggaacgaaaa eteaegttaa 3840 gggattttgg tcatgagatt atcaaaaagg atcttcacct agatcctttt aaattaaaaa 3900 tgaagtttta aatcaatcta aagtatatat gagtaaactt ggtctgacag ttaccaatgc 3960 ttaatcagtg aggcacctat ctcagcgatc tgtctatttc gttcatccat agttgcctga 4020 ctccccgtcg tgtagataac tacgatacgg gagggcttac catctggccc cagtgctgca 4080 atgataccgc gagacccacg ctcaccggct ccagatttat cagcaataaa ccagccagcc 4140 ggaagggccg agcgcagaag tggtcctgca actttatccg cctccatcca gtctattaat 4200 tgttgccggg aagctagagt aagtagttcg ccagttaata gtttgcgcaa cgttgttgcc 4260 attgctacag gcatcgtggt gtcacgctcg tcgtttggta tggcttcatt cagctccggt 4320 tcccaacgat caaggcgagt tacatgatcc cccatgttgt gcaaaaaagc ggttagctcc 4380 ttcggtcctc cgatcgttgt cagaagtaag ttggccgcag tgttatcact catggttatg 4440 gcagcactgc ataattctct tactgtcatg ccatccgtaa gatgcttttc tgtgactggt 4500 gagtactcaa ccaagtcatt ctgagaatag tgtatgcggc gaccgagttg ctcttgcccg 4560 gcgtcaacac gggataatac cgcgccacat agcagaactt taaaagtgct catcattgga 4620 aaacgttctt cggggcgaaa actctcaagg atcttaccgc tgttgagatc cagttcgatg 4680 taacccactc gtgcacccaa ctgatcttca gcatctttta ctttcaccag cgtttctggg 4740 tqaqcaaaaa caggaaggca aaatgccgca aaaaagggaa taagggcgac acggaaatgt 4800 tgaatactca tactcttcct ttttcaatat tattgaagca tttatcaggg ttattgtctc 4860 atgagcggat acatatttga atgtatttag aaaaataaac aaaagagttt gtagaaacgc 4920 aaaaaggcca teegteagga tggeettetg ettaatttga tgeetggeag tttatggegg 4980

4

```
gcgtcctgcc cgccaccctc cgggccgttg cttcgcaacg ttcaaatccg ctcccggcgg 5040
atttgtccta ctcaggagag cgttcaccga caaacaacag ataaaacgaa aggcccagtc 5100
tttcgactga gcctttcgtt ttatttgatg cctggcagtt ccctactctc gcatggggag 5160
accccacact accateggeg ctaeggegtt teacttetga gtteggeatg gggteaggtg 5220
ggaccaccgc gctactgccg ccaggcaaat tctgttttat cagaccgctt ctgcgttctg 5280
atttaatctg tatcaggctg aaaatcttct ctcatccgcc aaaacagaag ctagcggccg 5340
atccccaaaa aaaaaaaaa aaaaaaaaa aagagtccag agtggccccg ccgttccgcg 5400
ccggggggg gggggggg ggacactttc ggacatctgg tcgacctcca gcatcggggg 5460
aaaaaaaaa aacaaagttt cgcccggagt actggtcgac ctccgaagtt ggggggg
<210> 24
<211> 5699
<212> DNA
<213> Artificial Sequence
<220>
<223> Description of Artificial Sequence: pHL3236
<400> 24
cctctcataa tagacggcac agcctcatta agcccgggaa tgatgatggg tatgttcaac 60
atgctgagta cagtgttggg agtctcaatc ctgaatcttg ggcaaaagag atacaccaaa 120
accacatact ggtgggatgg acttcagtcc tctgatgatt ttgctctcat cgtgaatgca 180
ccaaatcatg agggaataca agcgggagtg gatagattct acagaacctg caagctagtt 240
gggatcaata tgagcaagaa aaagtcctat ataaatagga caggaacatt cgaattcaca 300
agetttttet accgetatgg atttgtagee aattttagta tggagttgee cagetttgga 360
gtatcaggaa ttaatgaatc ggctgatatg agcattggag taacagtgat aaagaataac 420
atgataaaca atgatcttgg accggcaaca gcccaaatgg ctctccaatt attcatcaag 480
gactacagat atacataccg gtgtcacagg ggagacacac aaatccaaac gaggaggtca 540
ttcgagctaa agaagctgtg ggagcagacc cgctcaaagg caggactgtt ggtttcagat 600
ggcggaccaa acctgtacaa cattcggaat ctccacatcc cggaagtttg cctgaaatgg 660
gaactaatgg atgaagacta tcagggaaga ctttgtaatc ccatgaaccc gtttgtcagt 720
cataaggaaa ttgaatctgt aaacaatgct gcggtaatgc cagcccatgg tccagccaaa 780
agcatggaat atgatgctgt ggcaactaca cactcttgga tccctaagag aaaccgttcc 840
attctcaata cgagtcaaag gggaatcctt gaggatgaac aaatgtacca gaagtgttgc 900
aacctattcg agaaattctt ccctagcagc tcatacagaa gaccagttgg aatttccagt 960
atggtggagg ccatggtgtc tagggcccgg attgatgcac gaattgactt cgagtctgga 1020
aggattaaga aggaagagtt tgctgagatc atgaagatcc cccgggctgc aggaattcga 1080
tatcaagctt cgacgaattt ctgccattca tccgcttatt atcacttatt caggcgtagc 1140
accaggegtt taagggcacc aataactgcc ttaaaaaaat tacgccccgc cctgccactc 1200
atcgcagtac tgttgtaatt cattaagcat tctgccgaca tggaagccat cacaaacggc 1260
atgatgaacc tgaatcgcca gcggcatcag caccttgtcg ccttgcgtat aatatttgcc 1320
catggtgaaa acgggggcga agaagttgtc catattggcc acgtttaaat caaaactggt 1380
gaaactcacc cagggattgg ctgagacgaa aaacatattc tcaataaacc ctttagggaa 1440
ataggccagg ttttcaccgt aacacgccac atcttgcgaa tatatgtgta gaaactgccg 1500
gaaatcgtcg tggtattcac tccagagcga tgaaaacgtt tcagtttgct catggaaaac 1560
ggtgtaacaa gggtgaacac tatcccatat caccagctca ccgtctttca ttgccatacg 1620
gaattccgga tgagcattca tcaggcgggc aagaatgtga ataaaggccg gataaaactt 1680
gtgcttattt ttctttacgg tctttaaaaa ggccgtaata tccagctgaa cggtctggtt 1740
ataggtacat tgagcaactg actgaaatgc ctcaaaatgt tctttacgat gccattggga 1800
tatatcaacg gtggtatatc cagtgatttt tttctccatt ttagcttcct tagctcctga 1860
aaatctcgtc gaagcttatc gataccgtcg acctcgaggg ggggcccggt acggcctgca 1920
aattttcaag aagatcattt ttcagctgat ctcgttatct agaccatgga gcttagtgat 1980
ggtgatggtg atgggatccc ttgtatagtt catccatgcc atgtgtaatc ccagcagctg 2040
 ttacaaactc aagaaggacc atgtggtctc tcttttcgtt gggatctttc gaaagggcag 2100
 attgtgtgga caggtaatgg ttgtctggta aaaggacagg gccatcgcca attggggtgt 2160
 tctgctggta gtggtcggcc agctgcacgc cgccgtcctc gatgttgtgg cgggtcttga 2220
```

4

```
agttggcctt gattccgttc ttctgcttgt cagccatgat gtatacattg tgtgagttat 2280
agttgtattc caatttgtgt ccaagaatgt ttccatcttc tttaaaatca atacctttta 2340
actcgattct attaacaagg gtatcacctt caaacttgac ttcagcacgt gtcttgtagt 2400
tcccgtcatc tttgaaaaat atagttcttt cctgtacata accttcgggc atggcactct 2460
tgaaaaagtc atgctgtttc atatgatctg ggtatcttga aaagcattga acaccataag 2520
tgaaagtagt gacaagtgtt ggccatggaa caggtagttt tccagtagtg caaataaatt 2580
taagggtaag ttttccgtat gttgcatcac cttcaccctc tccactgaca gaaaatttgt 2640
gcccattaac atcaccatct aattcaacaa gaattgggac aactccagtg aaaagttctt 2700
ctcctttact catggtggac tccttcgcga gtcgaggggg ggcccggtac acgtacgcgc 2760
tcgagaacgt accttcgcgc tcgcgatgtg gatgtcactc agtgagtgat tatctaccct 2820
gtttctactc cccccaact tcggaggtcg accagtactc cgggcgaaac tttgttttt 2880
ttttttcccc cgatgctgga ggtcgaccag atgtccgaaa gtgtcccccc ccccccccc 2940
ccccggcgcg gaacggcggg gccactctgg actcttttt ttttttttt tttttttt 3000
ggggatcggc cgctagcttc tgttttggcg gatgagagaa gattttcagc ctgatacaga 3060
ttaaatcaga acgcagaagc ggtctgataa aacagaattt gcctggcggc agtagcgcgg 3120
tggtcccacc tgaccccatg ccgaactcag aagtgaaacg ccgtagcgcc gatggtagtg 3180
tggggtctcc ccatgcgaga gtagggaact gccaggcatc aaataaaacg aaaggctcag 3240
togaaagact gggcctttcg ttttatctgt tgtttgtcgg tgaacgctct cctgagtagg 3300
acaaatccgc cgggagcgga tttgaacgtt gcgaagcaac ggcccggagg gtggcgggca 3360
qqacqcccgc cataaactgc caggcatcaa attaagcaga aggccatcct gacggatggc 3420
ctttttgcgt ttctacaaac tcttttgttt atttttctaa atacattcaa atatgtatcc 3480
gctcatgaga caataaccct gataaatgct tcaataatat tgaaaaagga agagtatgag 3540
tattcaacat ttccgtgtcg cccttattcc cttttttgcg gcattttgcc ttcctgtttt 3600
tgctcaccca gaaacgctgg tgaaagtaaa agatgctgaa gatcagttgg gtgcacgagt 3660
gggttacatc gaactggatc tcaacagcgg taagatcctt gagagttttc gccccgaaga 3720
acgttttcca atgatgagca cttttaaagt tctgctatgt ggcgcggtat tatcccgtgt 3780
tgacgccggg caagagcaac tcggtcgccg catacactat tctcagaatg acttggttga 3840
gtactcacca gtcacagaaa agcatcttac ggatggcatg acagtaagag aattatgcag 3900
tgctgccata accatgagtg ataacactgc ggccaactta cttctgacaa cgatcggagg 3960
accgaaggag ctaaccgctt ttttgcacaa catgggggat catgtaactc gccttgatcg 4020
ttgggaaccg gagctgaatg aagccatacc aaacgacgag cgtgacacca cgatgcctgt 4080
agcaatggca acaacgttgc gcaaactatt aactggcgaa ctacttactc tagcttcccg 4140
gcaacaatta atagactgga tggaggcgga taaagttgca ggaccacttc tgcgctcggc 4200
ccttccggct ggctggttta ttgctgataa atctggagcc ggtgagcgtg ggtctcgcgg 4260
tatcattgca gcactggggc cagatggtaa gccctcccgt atcgtagtta tctacacgac 4320
qqqqaqtcaq qcaactatqg atgaacgaaa tagacagatc gctgagatag gtgcctcact 4380
gattaagcat tggtaactgt cagaccaagt ttactcatat atactttaga ttgatttaaa 4440
acttcatttt taatttaaaa ggatctaggt gaagatcctt tttgataatc tcatgaccaa 4500
aatcccttaa cgtgagtttt cgttccactg agcgtcagac cccgtagaaa agatcaaagg 4560
atcttcttga gatccttttt ttctgcgcgt aatctgctgc ttgcaaacaa aaaaaccacc 4620
gctaccagcg gtggtttgtt tgccggatca agagctacca actctttttc cgaaggtaac 4680
tggcttcagc agagcgcaga taccaaatac tgtccttcta gtgtagccgt agttaggcca 4740
ccacttcaag aactctgtag caccgcctac atacctcgct ctgctaatcc tgttaccagt 4800
ggctgctgcc agtggcgata agtcgtgtct taccgggttg gactcaagac gatagttacc 4860
ggataaggcg cagcggtcgg gctgaacggg gggttcgtgc acacagccca gcttggagcg 4920
aacgacctac accgaactga gatacctaca gcgtgagcta tgagaaagcg ccacgcttcc 4980
cgaagggaga aaggcggaca ggtatccggt aagcggcagg gtcggaacag gagagcgcac 5040
gagggagctt ccagggggaa acgcctggta tctttatagt cctgtcgggt ttcgccacct 5100
ctgacttgag cgtcgatttt tgtgatgctc gtcagggggg cggagcctat ggaaaaacgc 5160
cagcaacgcg gcctttttac ggttcctggc cttttgctgg ccttttgctc acatgttctt 5220
tcctgcgtta tcccctgatt cattaatgca ggtcacgatc ctttctggcg agtccccgtg 5280
cggagtcgga gagcgctccc tgagcgcgcg tgcggcccga gaggtcgcgc ctggccggcc 5340
ttcggtccct cgtgtgtccc ggtcgtagga ggggccggcc gaaaatgctt ccggctcccg 5400
ctctggagac acgggccggc cccctgcgtg tggcacgggc ggccgggagg gcgtccccgg 5460
cccggcgctg ctcccgcgtg tgtcctgggg ttgaccagag ggccccgggc gctccgtgtg 5520
tggctgcgat ggtggcgttt ttggggacag gtgtccgtgt cgcgcgtcgc ctgggccggc 5580
ggcgtggtcg gtgacgcgac ctcccggccc cgggggaggt atatctttcg ctccgagtcg 5640
```

gcattttggg ccgccgggtt attagtagaa acaagggtat ttttctttac ctagctagg 5699